

## WHAT IS CLAIMED IS:

- 1 1. A method of producing an animation of a group  
2 including a plurality of members, said method  
3 comprising:  
4 a continuous processing step for determining the  
5 states of the respective members at each time step in  
6 accordance with predetermined dynamic characteristics  
7 of the respective members; and  
8 a discrete processing step for accepting, from the  
9 outside, a command specifying the overall state to be  
10 achieved for said group and assigning roles to the  
11 respective members of the group in accordance with the  
12 overall state specified by said command;  
13 wherein if new roles are assigned to members in  
14 said discrete processing step, the dynamic states of  
15 the respective members are adjusted, in said  
16 continuous processing step, in accordance with the  
17 assigned new roles.
- 1 2. A method of producing an animation of a group  
2 including a plurality of members, according to Claim 1,  
3 wherein said discrete processing step includes a role  
4 replacement step for replacing, among members, the

5 roles currently assigned to the respective members,  
6 and wherein said role replacement step is performed  
7 when a predetermined triggering condition is satisfied  
8 or when it is determined that the overall performance  
9 index of the group can be reduced by the role  
10 replacement..

1 3. A method of producing an animation of a group  
2 including a plurality of members, according to Claim 1,  
3 wherein in said discrete processing step, the roles of  
4 the respective members are determined so that the  
5 overall performance index of the group is minimized or  
6 reduced.

1 4. A method of producing an animation of a group  
2 including a plurality of members, according to Claim 2,  
3 wherein the overall performance index of the group is  
4 energy.

1 5. A method of producing an animation of a group  
2 including a plurality of members, according to Claim 2,  
3 wherein in said role replacement step, a plurality of  
4 members having the lowest performance indices are  
5 selected and roles are replaced among the plurality of  
6 selected members.

1 6. A method of producing an animation of a group  
2 including a plurality of members, according to Claim 2,  
3 wherein said role replacement step further includes  
4 the step of inhibiting, in response to a command given  
5 from the outside, the processing associated with the  
6 role replacement for a predetermined period of time.

1 7. An apparatus for producing an animation of a  
2 group including a plurality of members, said apparatus  
3 comprising:

4 a continuous processing means for determining the  
5 states of the respective members at each time step in  
6 accordance with predetermined dynamic characteristics  
7 of the respective members; and

8 a discrete processing means for accepting, from  
9 the outside, a command specifying the overall state to  
10 be achieved for said group and assigning roles to the  
11 respective members of the group in accordance with the  
12 overall state specified by said command;

13 wherein if new roles are assigned to members in  
14 said discrete processing means, the dynamic states of  
15 the respective members are adjusted, in said  
16 continuous processing means, in accordance with the  
17 assigned new roles.

1 8. An entertainment apparatus for simulating a

2 group including a plurality of interchangeable members,  
3 said apparatus comprising:

4 a continuous processing means for determining the  
5 states of the respective members at each time step in  
6 accordance with predetermined dynamic characteristics  
7 of the respective members; and

8 a discrete processing means for accepting, from  
9 the outside, a command specifying the overall state to  
10 be achieved for said group and assigning roles to the  
11 respective members of the group in accordance with the  
12 overall state specified by said command;

13 wherein if new roles are assigned to members in  
14 said discrete processing means, the dynamic states of  
15 the respective members are adjusted, in said  
16 continuous processing means, in accordance with the  
17 assigned new roles.

1 9. A method of controlling a system for  
2 simulating a group including a plurality of  
3 interchangeable members, said method comprising:

4 a continuous processing step for determining the  
5 states of the respective members at each time step in  
6 accordance with predetermined dynamic characteristics  
7 of the respective members; and

8 a discrete processing step for accepting, from the  
9 outside, a command specifying the overall state to be

10 achieved for said group and assigning roles to the  
11 respective members of the group in accordance with the  
12 overall state specified by said command;  
13 wherein if new roles are assigned to members in  
14 said discrete processing step, the dynamic states of  
15 the respective members are adjusted, in said  
16 continuous processing step, in accordance with the  
17 assigned new roles.

1 10. A method of, in a simulation of a group  
2 including N members where N is an integer equal to or  
3 greater than 2, controlling the movement of the  
4 members of the group so that the members are moved  
5 from locations in a predetermined initial layout in a  
6 state space to locations in a target layout, said  
7 method comprising the steps of:

8 a) assigning locations in said target layout to  
9 the respective members lying at locations in said  
10 initial layout so that the members are moved along the  
11 shortest distances to the locations in the target  
12 layout;

13 b) moving the members at the locations in said  
14 initial layout in accordance with the assignments made  
15 in step a);

16 c) calculating the value of a predetermined  
17 evaluation function associated with the movements,

18 accomplished in said step b), of the respective  
19 members to the assigned locations in the target  
20 layout;

21 d) selecting K members, where K is an integer  
22 equal to or smaller than N, having the greatest values  
23 of the evaluation function; and

24 e) replacing the assignments of the locations in  
25 the target layout within K! combinations of the  
26 selected K members,

27 wherein after completion of step e), the method  
28 returns to step b) so as to perform steps b) to e)  
29 repeatedly.

1 11. A recording medium readable by an information  
2 processor, recording a program for enabling the  
3 information processor to produce an animation of a  
4 group including a plurality of members, wherein said  
5 program enables the information processor to execute:

6 a continuous processing step for determining the  
7 states of the respective members at each time step in  
8 accordance with predetermined dynamic characteristics  
9 of the respective members; and

10 a discrete processing step for accepting, from the  
11 outside, a command specifying the overall state to be  
12 achieved for said group and assigning roles to the  
13 respective members of the group in accordance with the

14 overall state specified by said command;

15 wherein if new roles are assigned to members in  
16 said discrete processing step, the dynamic states of  
17 the respective members are adjusted, in said  
18 continuous processing step, in accordance with the  
19 assigned new roles.

1 12. A recording medium readable by an information  
2 processor, recording a program for enabling an  
3 information processor, in a simulation of a group  
4 including N members where N is an integer equal to or  
5 greater than 2, to control the movement of the members  
6 of the group so that the members are moved from  
7 locations in a predetermined initial layout in a state  
8 space to locations in a target layout, wherein said  
9 program enables the information processor to execute  
10 the steps of:

11 a) assigning locations in said target layout to  
12 the respective members lying at locations in said  
13 initial layout so that the members are moved along the  
14 shortest distances to the locations in the target  
15 layout;

16 b) moving the members at the locations in said  
17 initial layout in accordance with the assignments made  
18 in step a);

19 c) calculating the value of a predetermined

20 evaluation function associated with the movements,  
21 accomplished in said step b), of the respective  
22 members to the assigned locations in the target  
23 layout.

24 d) selecting K members, where K is an integer  
25 equal to or smaller than N, having the greatest values  
26 of the evaluation function; and

27 e) replacing the assignments of the locations in  
28 the target layout within K! combinations of the  
29 selected K members.

30 wherein after completion of step e), the method  
31 returns to step b) so as to perform steps b) to e)  
32 repeatedly.